Management of Transmediastinal Injuries

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18 year old male with GSW to the right chest

GCS 15

Patient was intubated in the ED

Diminished breath sounds on right side
Case Presentation

Physical Exam:
- VS: T96.8  SBP 100
- HR 116 O2 100%
- Chest: entry wound in 5th intercostal space mid-scapular
- CV: sinus tachycardia
- Abd: soft nontender, non distended
- Pelvis: stable

ABG: 6.89/40/400/7.3/98.3/-22.7
Case Presentation

- Chest tube was placed with 600 ml blood drained
- SBP increased to 120mm Hg.
- Received 2 units PRBCs
CT scan findings

• CT Chest:
  o Likely superior caval injury with active extravasation into large right hemothorax
  o Extensive mediastinal hematoma
  o Bilateral pneumothoraces

• CT abdomen/pelvis:
  o Poor enhancement of spleen and kidney compatible with hypoperfusion
Operation

- Bilateral anterolateral thoracotomies
  - EBL: 3000 mL
  - PRBCs: 9 units
  - Pulmonary artery repair
  - Continued bleeding ? Intercostal vessels
  - No pericardial blood; heart empty
  - Expired at 01: 49 am
Case Presentation

- ME report:
  - Injury to Superior vena cava
  - Injury to esophagus
  - Left common carotid off the aortic arch
  - Left subclavian vein
  - Landed in the left clavicular region
Outline

- Anatomy
- Initial evaluation
- Operative indications
- Operative Incisions
- Great vessel injury
Superior Mediastinum

- Thymus
- Brachiocephalic veins
- Superior vena cava
- Azygos vein
- Aortic arch
- Pulmonary arteries
- Vagus nerve
- Phrenic nerves
Inferior mediastinum

- **Anterior:**
  - Caudal thymus gland
  - Sternopericardial ligaments
- **Middle:**
  - Heart and great vessels
  - Phrenic nerves
- **Posterior:**
  - Descending aorta
  - Esophagus
  - Thoracic duct
  - Sympathetic chains
  - Vagus nerves
  - Hemiazygos vein
Initial Evaluation

- ATLS
- Reconstruct the path
- Physical exam – breath sounds, subcutaneous emphysema, elevation of jugular venous pulsation
- CXR
- Judicious fluid administration
Management of Chest Trauma

- **Tube thoracostomy:**
  - 1500 mL initial bloody drainage or greater
  - >250 mL per hour

- **Hemodynamically stable patients with injury that traverse mediastinum:**
  - Endoscopy/ arteriography
  - CT scan
## Acute Indications for Thoracotomy

<table>
<thead>
<tr>
<th>Indication</th>
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<tbody>
<tr>
<td>Acute hemodynamic deterioration</td>
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<tr>
<td>And cardiac arrest in trauma center</td>
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<tr>
<td>Penetrating truncal trauma</td>
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<tr>
<td>Cardiac tamponade</td>
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<tr>
<td>Hemopericardium</td>
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<tr>
<td>Vascular injury at thoracic outlet</td>
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<td>Massive air leak from chest tube</td>
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</table>
### Acute Indications for Thoracotomy

- **Endoscopic or radiographic evidence of tracheal/bronchial injury**
- **Great vessel injury radiographic**
- **Missile embolism to heart or pulmonary artery**
- **Traumatic thoracotomy**
- **True mediastinal traverse with penetrating object**
- **Suspected cardiac herniation**
Operative Incisions

- **Left anterolateral thoracotomy:**
  - Resuscitation under acute deterioration or cardiac arrest
  - Exposure for opening pericardium, open cardiac massage, clamping of descending thoracic aorta
  - Left lung and cardiac injuries

Injury to the aorta, intercostal arteries, esophagus and phrenic nerve


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Transsternal extension

Trauma to the Right Heart


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Operative Incisions

- **Right posterolateral:**
  - *Pulmonary
  - *Tracheal
  - *mid-esophageal injuries
  - SVC, IVC, azygous vein
Operative Incisions

- **Left posterolateral:**
  - Posterior mediastinum
  - Left lung
  - Hilum
  - Descending thoracic aorta
  - Heart for cardiac massage
  - Proximal L. subclavian
  - Some access to proximal L common carotid artery
Operative Incisions

- **Median Sternotomy:**
  - **PROS:**
    - Excellent exposure for isolated anterior cardiac and great vessel injuries
    - Anterior mediastinal structures: ascending aorta, innominate artery and left common carotid
  - **CONS**
    - Provides NO access to esophagus and posterior thorax
    - Difficult to clamp the thoracic aorta
Operative Incisions

- **Right anterolateral:**
  - Right lung and chest injury
“Trap door” or “book” incision:
- Exposure to long segment of L common carotid and L subclavian artery
- Sternocleidomastoid cut to facilitate exposure
  - Avoid injury to phrenic nerve
- Difficulties include stretching the brachial plexus
THORACIC GREAT VESSEL INJURY

- 90% - penetrating trauma
  - Length of knife
  - Firearm type
  - Number of rounds fired
  - Distance from firearm

- Gunshot injury traversing mediastinum
  - Hemodynamic instability from thoracic vascular injury-50%
  - Operative mortality 20-40%

<table>
<thead>
<tr>
<th>Clinical Presentation of Great Vessel Injury</th>
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<tbody>
<tr>
<td>- Hypotension</td>
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<td>- Upper extremity hypertension</td>
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<tr>
<td>- Unequal blood pressures or pulses in extremities</td>
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<tr>
<td>- External evidence of major chest trauma</td>
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<tr>
<td>- Expanding hematoma at thoracic outlet</td>
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<tr>
<td>- Intrascapular murmur</td>
</tr>
<tr>
<td>- Palpable fracture of sternum</td>
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<tr>
<td>- Palpable fracture of thoracic spine</td>
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<tr>
<td>- Left flail chest</td>
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</table>
CXR findings to suggest penetrating thoracic great vessel injury:

- Large hemothorax
- Foreign bodies or trajectories in proximity to great vessels
- Trajectory with confusing course
- “Missing” missile with GSW to chest to suggest distal embolization in arterial tree
  - Injury to heart, esophagus, trachea, spinal cord, major vasculature
  - Spiral CT
Specific Injuries Algorithm

**SPECIFIC INJURIES**

- Ascending aorta
- Innominate artery
- Right carotid/Subclavian artery
- Left carotid artery

- Left subclavian artery

- Known descending thoracic aorta
- Intrathoracic left subclavian artery

- Known intrathoracic trachea/esophagus injury

- Clotted hemothorax
- VATS

- Median sternotomy with neck/supraclavicular extension

- Third interspace anterolateral thoracotomy with supraclavicular incision

- Left posterolateral thoracotomy

- Posterolateral thoracotomy

- Posterolateral thoracotomy


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1997-2003
Retrospective review; 207 patients

Fig 1. Management algorithm for a patient with penetrating mediastinal trauma. *Performed as needed. (CTA = computed tomographic angiogram scan.)

WOUND CLASSIFICATION:

M1- base of neck into mediastinum or pleura

M2-1 pleural cavity or mediastinum violation

M3-parasternal injury within nipple line or <4 cm

M4- 2 pleural cavities and mediastinal trasverse

Table 3. Injury Location at Initial Clinical Presentation

<table>
<thead>
<tr>
<th></th>
<th>Total n GSW (%)</th>
<th>Stable n (%)</th>
<th>Unstable n (%)</th>
<th>Death n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>16 (31)</td>
<td>10 (63)</td>
<td>6 (37)</td>
<td>2 (13)</td>
</tr>
<tr>
<td>M2</td>
<td>34 (50)</td>
<td>26 (76)</td>
<td>8 (24)</td>
<td>5 (15)</td>
</tr>
<tr>
<td>M3</td>
<td>137 (36)</td>
<td>92 (67)</td>
<td>45 (33)</td>
<td>28 (20)</td>
</tr>
<tr>
<td>M4</td>
<td>20 (100)</td>
<td>7 (35)</td>
<td>13 (65)</td>
<td>12 (60)</td>
</tr>
</tbody>
</table>

GSW = gunshot wound;  M1–M4 = see Fig 2.
Results

- 72/207 patients (35%) – unstable
  - 40 patients – OR- Most common- pulmonary and great vessel injury

**In stable patient -
No signs of missed injury

![Diagram of patient evaluation process]

*Fig 3. Evaluation of the stable patients: results of the diagnostic algorithm. Number of patients in each category listed in parenthesis and percentages reflect the group of stable patients only. (CTA = computed tomographic angiogram scan)*
• Trauma. 6th edition. Feliciano, Mattox
• Triage and Outcome of Patients with Mediastinal Penetrating Trauma. Annal Thorac. Surg